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MEMORANDUM FOR PRS (In-House Publication)

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SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-AB-2001-233**
Cooper & Shepherd (CIT); T.H. Sobota and K.C. Moore (APR, Inc.), "Thermal and Catalytic Cracking of JP-10 for Pulse Detonation Engine Applications" *ABSTRACT ONLY*

AIAA/ASME/SAE/ASEE JPC **(Statement A)**
(Indianapolis, IN, 7-10 July 2002) (Deadline: extended)

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Thermal and Catalytic Cracking of JP-10 for Pulse Detonation Engine Applications

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Practical air-breathing pulse-detonation engines (PDE) will be based on storable liquid hydrocarbon fuels such as JP-10. However, such fuels are not optimal for PDE operation due to the high energy input required for direct initiation of a detonation and the long deflagration-to-detonation transition times associated with low-energy initiators. These effects increase cycle time and reduce time-averaged thrust, resulting in a significant loss in performance. In an effort to utilize such conventional liquid fuels and still maintain the performance of the lighter and more sensitive hydrocarbon fuels, various fuel modification schemes such as thermal or catalytic cracking have been investigated.

The results of previous catalytic cracking experiments have quantified the cooling capabilities, i.e., using endothermic reactions to absorb energy generated by the propulsion system. The focus was on selecting liquid fuels and reactor operating conditions that produce desirable reaction products with high heat sink capabilities. In the present study, we examined the combustion properties of JP-10 that have been modified by thermal and catalytic cracking. The goals of our program are to understand the implications for pulse-detonation engine performance when operating with modified fuels.

We have developed a bench-top reactor system that can be used to process liquid fuel using either thermal or catalytic schemes. The system has the capabilities to vaporize liquid fuel at a precise flow rate while maintaining the flow path at temperatures up to 200°C and pressures up to 13.6 atm (200 psi) for extended periods of time. The reactor section can be heated up to 500°C and contains a packed-bed of zeolite catalyst. The reaction products can be analyzed on line and also stored in a reservoir for future use in combustion experiments. An Agilent 6890 Gas Chromatograph with an HP-5 capillary column and flame ionization detector, connected to the output of the reactor, is used to speciate the reaction products. Additional characterization of the products will involve direct testing of the reaction products in a PDE simulator, measurements in detonation tubes, and also in combustion vessels. Properties of interest include detonation and flame speeds, single-cycle impulse, and high-speed combustion behavior.